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Assessment of cod in Division 4X in 2003

Évaluation de la morue de la division 4X en 2003

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ABSTRACT

Landings for 4X cod have been restricted by total allowable catch to 6,000t for the 2000 – 2003 fishing years to promote an increase in population biomass. Despite the record low landings, survey catches do not show any clear increase in biomass in the past five years. While catches are about average in the Bay of Fundy, on the Scotian Shelf, the ITQ (mobile gear <65 ft fleet) survey indicates there has been little change in biomass, while the RV survey catch has declined. Recruitment indices have improved, particularly in the Bay of Fundy, starting with the 1998 yearclass, and growth rate and condition remain at or above average. Overall, biomass is expected to increase for 4X cod; however, unequivocal indications of improvement on the Scotian Shelf are needed to ensure the improvement is widespread.

RÉSUMÉ

Au cours des années 2000 à 2003, les débarquements de morue de 4X ont été limités à 6 000 t par le total autorisé des captures afin de favoriser une augmentation de la biomasse de la population. Malgré les faibles débarquements records, les prises de relevé ne révèlent aucune augmentation évidente de la biomasse au cours des cinq dernières années. Bien que les prises dans la baie de Fundy se situent au niveau de la moyenne, le relevé du QIT (flottille de pêche aux engins mobiles <65 pi.) effectué sur le plateau néo-écossais indique peu de changement dans la biomasse, tandis que les prises du relevé de NR ont diminué. Les indices de recrutement sont à la hausse, en particulier dans la baie de Fundy, commençant à la classe d'âge 1998, tandis que le taux de croissance et le facteur de condition se situent à ou au-dessus de la moyenne. Dans l'ensemble, on s'attend à ce que la biomasse augmente, mais il nous faut des preuves non équivoques d'amélioration sur le plateau néo-écossais pour dire que cela est généralement le cas.

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INTRODUCTION

Landings of cod from NAFO Subdivision 4X (including the Canadian portion of 5Y; Fig. 1) increased through the 1960s as large offshore trawlers became active in the fishery (Table 1; Fig. 2). Landings declined in 1970, primarily due to restrictions on haddock fishing. Landings peaked again in the early 1980's, due to increases in inshore catches. In 1981, handline landings exceeded 5,000t (Table 1), and landings in 4Xo exceeded 12,000t (Table 2). Recent landings are, in part, a reflection of the TAC which declined from 26,000t in 1992 to 6,000t in 2000 (Table 3). The quota has been held at 6,000t for 4 years as part of a rebuilding strategy for 4X cod. As of September 24th, 2003, 2,800t of cod had been landed.

The fishery takes place year round, generally peaking in June and July (Table 3). Landings from the winter declined after 1992, with many fishing sectors treating cod as a by-catch as they pursued other species. Since 2000, the quota year has run from April 1st. With this change in fishing year, and the increase in haddock quotas relative to cod, the winter haddock fishery has increased, and winter landings of cod have also increased.

In 2001 and 2002, the cod fishery was reported to have improved in most areas, aside from coastal hook and line fisheries. The distribution of landings was similar to recent years, with a high proportion of landings in the Bay of Fundy (4Xqrs5Y; Fig. 3), and Georges and Crowell Basins (4Xp). This is a general pattern in the groundfish fishery and reflects shifts in the distribution of abundance for a number of species. Most groups reported no difficulty in catching their quota despite the fact that many were directing their effort primarily for haddock. Fishing in inshore areas of 4Xo, however, was poor for both cod and haddock, with fishermen having to travel further offshore. In 2002, landings of cod from 4Xo declined below 1,000t for the first time (Table 2).

In 2003, fishing is reported to have been poor in most coastal areas. Many fixed gear fishers delayed their activity this year (Table 3), reportedly due to the prevalence of dogfish early in the summer and low water temperatures.

The number of vessels active in the fishery in 4X appears to have stabilised, except for handline, which continues to decline (Table 4). Reported fishing effort for groundfish is stable but low for all fixed gear sectors in recent years (Table 5). Data on days fished are not available for much of the fleet prior to 1996, however the total number of trips by gear type had declined by 1996 from a peak in 1992 (Clark 1997). Effort shows a similar decline for otter trawlers (Fig 4).

There were numerous anecdotal reports of cod being discarded or landed unreported in 2000 and 2001 to avoid exceeding the quota. This was thought to have decreased in 2002. There have been few reports from industry of discarding in 2003, and some have maintained that it was never a serious problem.

Some industry members expressed concern that the winter flounder trawl fishery in 4Xr cannot use separator trawls in an area in which cod bycatch is difficult to avoid. It has

been alleged that discarding of cod in the flatfish fishery may be a problem. Increased monitoring of this fishery could resolve this issue.

In response to concerns that vessels may be landing fish without reporting it, data on at sea sightings were examined. Surveillance information indicates that vessels observed fishing without matching records from log books are exceptions and their presence can generally be explained (e.g. fishing for lobster).

Discrepancies in species composition between trips carrying an observer and unobserved trips may be indicative of potential discarding or misreporting of landings. The level of observer coverage in 4X is generally below 1% (Table 6), too low for any meaningful comparisons. Much higher coverage stratified to account for heterogeneity in the fishery would be required to make useful comparisons of observed and unobserved trips. Experience with the 5Z groundfish fishery, which is less heterogeneous, suggests that 10% observer coverage may not always be sufficient for detecting potential discarding.

Catch and Weight at Age

Fishery Samples

Catch at age was derived following standard protocols for this stock (Clark et al, 2002). Length frequency samples were aggregated to give catch at length by gear, area and quarter-year, while age-length keys were produced for area and quarter (Table 7).

Landings

The size composition of the catch peaks at a somewhat lower length on the Shelf than in the Bay of Fundy, reflecting differences in growth between these areas (Fig. 5). In both areas the peak is consistent with length at age 4, the 1998 year-class.

In both 2001 and 2002 the 1998 yearclass dominated the landings of 4X cod (Table 8: Fig. 6). The contributions from ages 7 and over were very low (Fig 7). In 2003, landings are dominated by the 1998 and 1999 yearclasses. The age range in the fishery shows some expansion, with age 7 (the 1996 yearclass) comprising a higher than average proportion of landings (Table 8).

Weights-at-age from the commercial fishery have been higher in recent years in both the Bay of Fundy and Scotian Shelf areas (Table 9).

ABUNDANCE INDICES

The annual DFO Research Vessel (RV) survey, employing a stratified random survey design, with about 70 stations sampled annually, and the joint DFO/industry small dragger survey (ITQ), which employs a fixed station design with 184 stations, are used for abundance indices for this resource (Clark et al 2002). The DFO Research vessel survey has been conducted annually since 1970, however, due to uncertainties in appropriate

conversion factors to apply in relation to changes in vessel and net, only data after 1982 are used as indices (Clark et al 2002).

The distribution of large catches of cod in the RV survey was very restricted in 2003, with no large catches outside the Bay of Fundy (Fig. 8). There were many null sets on the Scotian Shelf, and catches on and around Browns Bank were poor compared to recent years.

The distribution of catches in the ITQ survey in 2003 was similar to past years (Fig. 9), with the largest sets on German Bank, Roseway Bank and in the Bay of Fundy. There were many sets where catch for that location was below the median for the survey series in the Bay of Fundy, while in inshore areas (not covered by the RV survey) many catches were above the median (Fig. 10).

The catch per tow of cod for the research vessel (RV) survey in the Bay of Fundy was above the median in 2002 and 2003, but has been below the median on the Scotian Shelf since 1998, dropping markedly in 2003 (Fig. 11).

ITQ survey catch was about average in the Bay of Fundy in 2003 (Fig. 12). There has been little change in catch on the Scotian Shelf for the ITQ survey throughout the series.

ITQ survey catches at length were similar to the median for most lengths in the Bay of Fundy, and well above the median from 28-49 cm on the Shelf (Fig. 13). The ITQ survey catches were consistent with commercial catches in showing a broad plateau in modal length in the Bay of Fundy, and a gradual decline in abundance at length through the commercial range on the Scotian shelf, with roughly twice as many caught in the low 50 cm range as at 70 cm.

RV survey catches in 2003 were at or above the median at most lengths in the Bay of Fundy, but very low for lengths >28cm on the Scotian Shelf (Fig. 14). The absence of a mode for the Scotian Shelf size composition is not consistent with the size composition from the ITQ survey or the fishery and is unlikely to be representative of the population.

Some of the difference in the survey catches is due to differences in catchability at length by the gear employed. The ITQ survey uses rock hopper foot gear which leaves little space for escape below the footrope, and has proportionately higher catches of cod less than 50cm. The differences between the two surveys may also simply reflect high variability in survey catches, as is seen in inter-annual variability in the longer RV series, or differences in the completeness of geographic coverage of the 4X area.

Recruitment indices (age 2) in the RV survey were generally low from 1995 to 1999 (Table 10, Fig. 15). The recruitment index improved in 2000, and has been above the median in 2001 to 2003. The 2001 yearclass was above the median at ages 0 and 1. These recent improvements are apparent primarily in the Bay of Fundy (Table 10b), while catch at age 2

on the Scotian Shelf has remained low since 1995, with catches in 2002 and 2003 among the lowest in the series (Table 10c).

While the ITQ survey does not provide a historical perspective, catch at age 2 is highest for the 1998, 1999, and 2001 yearclasses (Table 11; Figure 16). This is due primarily to catches in the Bay of Fundy, however, catches on the Shelf have also been higher. Catch at age 2 is highest on the Shelf in 2002 and 2003.. Catches of the 2000 yearclass have been the highest in the series at ages 0, 1 and 2, and second highest for the series at age 3.

Lengths at age from the RV survey show some variability over time, particularly on the Scotian Shelf, but no consistent trend across ages (Figure 17).. Condition (Fulton's K) has been very stable in the Bay of Fundy (Fig.18). Cod from the Scotian Shelf have shown greater variability in condition. Condition dropped to a low in 1985, but has been fairly stable at average levels recently.

The proportion of RV survey sets where cod are caught (area occupied) in the Bay of Fundy has been variable but remains about average, while on the Scotian Shelf it has declined annually since 1999 (Fig. 19). For the ITQ survey there has been little change for the Bay of Fundy, but a slight declining trend for the Scotian Shelf since 1998 (Fig. 20).

Total mortality (Z), as calculated from the RV survey has high inter-annual variability (Fig. 21). The absence of any apparent trend is not consistent with the reductions in nominal landings and fishing effort.

Dividing commercial landings by survey biomass is an estimate of relative fishing mortality. This has declined in recent years, reflecting the reduction in landing and generally stable overall (Bay of Fundy and Scotian Shelf) survey biomass index (Fig. 22). Estimates of relative fishing mortality for the Bay of Fundy and Scotian Shelf separately requires partitioning of the catch, which is currently not available.

The strong retrospective observed in the sequential population analysis (SPA) was thought to indicate a high level of unaccounted mortality. This could be caused by elevated natural mortality, but appeared to be highest on fishable ages, which would be consistent with a high level of discarding or unreported landings. It may also be confounded by divergent trends in the Bay of Fundy and Scotian Shelf. Reliable interpretation of SPA results cannot be made without resolving these issues.

Sources of Uncertainty

The principal source of uncertainty in evaluation of stock status in 4X cod is the amount of removals in each year. Reports of current and historical discarding and under-reporting indicate that these vary from year to year. Prior to the mid-1980s misreporting could also have included over-reporting of landings from other species or areas as 4X cod. This uncertainty can potentially be alleviated in future years with additional effort in monitoring

and following delineation of stock components. Inter-annual variability in natural mortality must also be considered.

This management unit has been treated as a stock complex comprised of a number of spawning components. Difficulty in separating landings has precluded analyses of discreet components. The similarities in past abundance trends for components had alleviated concerns about treatment as a single management unit. A divergence in population trends among these components would be inconsistent with model assumptions. Efforts to delineate components based on tagging and biological data are underway.

Outlook

Recruitment appears to have improved for the 1998 and 1999 yearclasses, following 5 years of poor recruitment. Initial estimates for the 2001 yearclass indicate it may be above the median for 1983-2003. It remains unclear, however, how widespread this improvement is within 4X. While both surveys indicate recent recruitment is strong in the Bay of Fundy, they give divergent indications for the 2000 and 2001 yearclasses on the Scotian Shelf. Ages 4 and 5 are generally dominant in the catch on the Scotian Shelf, thus their relative abundance should be apparent from the fishery in 2004.

Area occupied has declined on the Scotian Shelf, but remains about average in the Bay of Fundy. Condition and length-at-age are both about average with little recent variation.

Overall biomass has not increased since 1999, when the quota was reduced to 6,000t to promote recovery, therefore an increase in quota above 6000t is not supported. While biomass remains about average in the Bay of Fundy, the RV survey suggests a decline in cod abundance on the Scotian Shelf recently. While this is not supported by the ITQ survey results, some attention may need to be given to the distribution of catch between the Bay of Fundy and the Scotian Shelf until unambiguous signs of improvement are seen for the Shelf. Recent landings in this area have declined and were the lowest ever recorded in 2002.

A prospective gradual increase in biomass for 4X cod in the short-term can be anticipated due to improvements in recruitment following the 1997 yearclass, if fishery catches are kept to 6000 t.

Management Considerations

While there is a great deal of variability in species composition among fishing trips, there is some degree of predictability in species composition which will be observed in the fishery over broad geographical areas. Analysis of fishery data suggests there are areas which can be fished by hook and line and mobile gear where high ratios of haddock to cod may be caught.

The otter trawl fishery has in recent years focussed in 4Xpqrs, and in 4Xn in winter. The ratio of haddock to cod in the winter can exceed 10:1 in several areas, and is generally above this in 4Xn (Table 12). High ratios of haddock to cod are also experienced in 4Xp and 4Xs in summer months. Longliners fish primarily in 4Xmnop. Throughout the year in offshore areas (including Roseway and LaHave Banks, all of 4Xn and 4Xp south of Browns Bank), longliners can catch more haddock than cod (Table 13).

These data can be summarized to identify areas which, within a given season, will generally provide a high ratio of haddock to cod.

2002 cod and haddock directed landings (tonnes) where haddock is predominant

Area	Gear	Month	cod	had	had/cod
4Xn	otter trawl	jan.-may	62	1059	17.1
4Xp	otter trawl	july-nov.	69	628	9.1
4Xs	otter trawl	june-dec.	294	1013	3.4
offshore	longline	may-oct.	791	1263	1.6
offshore	longline	jan.-apr.; nov.-dec.	261	454	1.7

offshore = 4Xn, 4Xp at depths >100m, and Roseway Bank and Basin in 4Xo

It is possible, therefore, that an increase in haddock quota could be considered without leading to increased cod catches, if the fishery operates in those areas where haddock is more abundant. Enhanced monitoring of species composition through increased observer coverage should be considered if haddock:cod TAC ratio is increased.

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We would like to thank Stratis Gavaris for his constructive assistance in completing this document. Of special note is the contribution of Ralph Halliday. Ralph provided us with slightly charred hand-copied tables of summarized cod landings from the 1950's and early 1960's which he had rescued after a fire. These summaries do not appear to be available elsewhere, and add to our knowledge of the history of this fishery.

References

Clark, D. S., 1997. Assessment of cod in Division 4X in 1997. CSAS Res. Doc. 97/110.

Clark, D. S., S. Gavaris and J. M. Hinze, 2002. Assessment of cod in Division 4X in 2002. CSAS Res. Doc. 2002/105.

Table 1. Canadian landing of cod in 4X (and Canadian portion of 5Y) by gear type and tonnage class.

	Otter Trawl					Gill Net		Long Line			Hand		
Year	0&1	2	3	4	5+	0&1	2&3	0&1	2	3+	Line	Misc.	Total
1953	27	87	53	3								12,884	13,054
1954	34	113	17	7						321		13,914	14,406
1955	51	121	6	10						271		12,973	13,432
1956	118	104	42	4					376	414		13,791	14,489
1957	240	173	143						1,777	370		10,876	13,579
1958	240	314	127	52				1	1,197	591		8,552	11,074
1959	552	565	234						1,182	608		9,679	12,866
1960	578	426	229	10		1		2,740	1,007	497	4,802	1,833	12,123
1961	505	735	390	12		520		2,269	1,502	597	4,661	1,209	12,400
1962	565	1,007	971	410		645		2,883	1,337	456	4,571	1,702	14,547
1963	258	877	1,159	1,414		748		2,839	1,021	398	5,417	1,660	15,791
1964	457	1,484	1,610	4,163		750		2,672	1,151	677	5,403	4,442	22,809
1965	466	1,758	2,320	7,857		765		3,502	885	564		6,132	24,249
1966	284	2,023	3,064	7,222	72	851		3,733	513	702		5,700	24,164
1967	6,026	2,358	3,377	7,281	1,483	1,847		3,027	373	940	5,205	1,598	33,515
1968	253	2,245	3,684	7,596	3,111	1,856	0	3,482	479	806	5,766	1,509	30,787
1969	207	1,385	2,448	4,298	3,721	926	0	3,554	513	681	4,446	1,533	23,712
1970	158	1,151	1,529	1,960	1,259	653	0	4,171	515	768	3,444	2,410	18,018
1971	81	1,097	1,611	1,799	1,220	546	4	5,472	691	1,575	4,421	1,783	20,300
1972	121	1,235	1,635	2,246	1,371	1,187	0	6,119	668	1,174	3,128	1,646	20,530
1973	100	1,214	1,232	1,350	553	669	0	7,407	1,048	1,641	3,672	1,105	19,991
1974	128	1,433	1,310	575	577	1,851	0	6,834	1,400	1,096	3,247	490	18,941
1975	129	2,666	1,298	460	601	1,482	27	6,013	1,600	781	2,526	2,001	19,584
1976	82	1,025	1,263	436	896	2,403	167	4,828	1,067	1,479	2,867	525	17,038
1977	298	1,972	2,909	527	1,065	2,052	79	6,151	1,831	907	2,943	1,254	21,988
1978	615	1,805	2,573	745	1,731	2,562	96	6,904	2,216	1,149	2,059	1,264	23,719
1979	663	1,749	2,744	1,139	1,405	3,527	116	7,517	2,051	862	4,140	2,770	28,683
1980	1,322	2,769	4,284	1,042	2,037	2,683	61	8,356	2,360	898	4,198	1,267	31,277
1981	1,165	3,086	2,989	416	1,131	2,871	114	10,302	2,555	1,235	5,174	483	31,521
1982	879	3,159	4,493	563	2,217	3,154	214	9,120	3,465	1,087	4,299	484	33,134
1983	638	4,735	6,306	518	1,118	2,180	235	5,747	2,757	883	3,750	604	29,471
1984	964	4,198	5,904	302	1,513	1,248	220	3,916	2,825	980	3,005	453	25,528
1985	523	3,954	5,562	90	1,185	1,837	161	2,617	1,740	635	2,755	440	21,499
1986	573	3,663	5,123	224	974	1,453	196	2,479	1,918	576	2,490	371	20,040
1987	312	2,645	3,504	531	929	1,968	241	3,075	2,175	499	2,670	456	19,005
1988	454	3,966	3,542	160	467	903	444	3,528	3,149	672	3,081	171	20,537
1989	409	3,933	4,184	67	713	1,254	475	2,915	2,167	623	2,937	208	19,885
1990	505	3,668	3,577	268	170	1,933	692	4,201	2,967	849	4,871	203	23,904
1991	355	4,598	5,805	298	751	2,225	619	4,712	3,679	842	3,737	128	27,749
1992	238	4,494	5,711	143	726	1,811	586	4,455	3,574	719	3,517	106	26,080
1993	176	2,778	3,598	68	241	1,387	523	2,768	1,693	310	2,439	45	16,026
1994	132	2,022	2,343	138	82	993	421	2,837	1,412	231	2,367	67	13,045
1995	100	1,387	1,619	112	75	470	507	1,632	959	182	1,706	18	8,767
1996	92	1,552	2,314	157	103	611	442	1,774	1,306	201	1,914	106	10,572
1997	79	2,094	2,430	136	35	694	471	2,013	1,255	231	1,794	6	11,238
1998	96	1,407	1,892	166	22	429	376	1,663	997	244	879	0	8,169
1999	85	776	1,254	63	11	494	404	1,480	762	119	743	0	6,190
2000	113	851	1,268	78	9	358	356	1,420	533	106	662	1	5,755
2001	120	975	1,292	29	9	383	390	1,532	423	72	409	0	5,707
2002	181	874	1,482	0	51	520	535	1,487	395	55	286	2	5,869
2003	149	394	903	8	5	110	268	261	95	35	53	2	2,281

Landings for 2003 include Jan 1-June 30 only.

Table 2. Nominal catch of 4X cod by unit area.

Year	4Xm	4Xn	4Xo	4Xp	4Xq	4Xr	4Xs	4Xu	5Y	Shelf	Fundy	Foreign	Total
1956	1,981	1,043	5,909		756	2,648	817			8,933	4,221	1,663	13154*
1957	1,929	1,447	6,369		934	2,041	616			9,745	3,591	1,083	14,419
1958	1,480	1,130	5,056		651	1,859	774			7,666	3,284	1,110	12,060
1959	2,212	937	5,302		1,123	2,339	1,340			8,451	4,802	862	14,115
1960	1,654	963	5,164		885	2,373	828			7,781	4,086	1,605	13,472
1961	1,630	1,279	5,275	24	892	2,449	905			8,208	4,246	1,272	13,726
1962	1,520	1,031	6,250	651	768	2,946	1,327			9,452	5,041	1,280	15,773
1963	1,862	829	6,861	1,443	767	2,419	1,579			10,995	4,765	1,995	17,755
1964	2,194	2,178	7,471	3,334	1,093	3,572	1,317			15,177	5,982	4,688	25,847
1965	1,665	2,088	6,526	7,733	962	4,091	1,215			18,012	6,268	2,693	26,973
1966	2,201	1,521	5,444	7,254	1,099	4,607	2,032			16,420	7,738	6,746	30,904
1967	2,384	1,400	7,120	8,041	1,276	5,425	2,051			18,945	8,752	4,651	32,348
1968	3,251	2,059	8,159	9,341	1,327	4,785	1,849	4	65	22,810	8,030	4,776	35,616
1969	2,413	2,923	7,355	5,523	947	3,686	1,120	59	60	18,214	5,872	8,704	32,790
1970	2,851	1,300	6,966	2,310	1,077	2,621	847	23	26	13,427	4,594	4,308	22,329
1971	2,750	1,728	9,029	2,157	1,395	2,355	754	13	119	15,664	4,636	3,197	23,497
1972	3,124	1,585	8,908	1,421	1,938	2,818	977	7	52	15,038	5,792	1,902	22,732
1973	2,130	1,478	10,180	1,228	1,742	2,186	802	179	67	15,016	4,976	2,222	22,214
1974	2,243	1,122	9,369	955	1,526	2,839	768	1	120	13,689	5,254	2,166	21,109
1975	81	1,374	967	1,033	864	2,867	133	12,180	86	3,455	16,130	1,598	21,183
1976	1,973	1,408	8,267	743	1,061	2,034	601	40	16	12,391	3,752	519	16,662
1977	184	1,706	1,229	1,487	907	2,686	122	13,562	105	4,606	17,382	378	22,366
1978	2,812	2,864	8,522	3,591	2,286	2,246	676	341	382	17,789	5,931	301	24,021
1979	6,565	2,750	10,495	1,748	2,325	2,550	1,646	229	379	21,558	7,129	78	28,765
1980	5,205	3,325	9,899	1,561	3,571	4,684	2,278	47	166	20,023	10,712	541	31,276
1981	4,767	2,114	12,097	1,830	2,413	5,072	2,031	419	599	21,051	10,290	179	31,520
1982	5,255	2,922	10,451	2,079	3,715	4,571	2,009	538	1,349	20,956	11,933	245	33,134
1983	3,437	1,690	8,537	2,497	3,160	3,787	1,674	1,826	2,543	16,891	12,258	320	29,469
1984	2,255	2,251	6,192	1 655	2,244	2,959	1,414	3,583	2,698	14,110	11,141	277	25,528
1985	3,006	1,199	5,438	1,026	1,999	2,301	1,511	3,608	1,364	12,236	9,216	47	21,499
1986	2,914	1,762	4,670	544	1,754	1,802	1,500	4,469	557	11,748	8,224	68	20,040
1987	2,676	1,611	4,777	1,131	1,240	858	1,207	5,116	360	12,783	6,179	29	18,991
1988	1,502	1,086	5,458	1,271	1,124	850	1,103	7,990	142	14,814	5,711	11	20,536
1989	1,370	1,019	5,506	2,820	1,360	1,112	915	5,267	478	13,855	5,994	38	19,887
1990	1,846	764	7,915	1,746	2,238	1,721	1,722	5,404	326	15,551	8,119	222	23,892
1991	2,552	1,584	8,963	2,440	2,763	4,243	2,560	2,246	307	17,275	10,383	91	27,749
1992	1,523	1,818	10,347	1,455	2,919	3,352	1,503	2,876	278	17,556	8,515	9	26,080
1993	1,364	1,646	4,845	1,436	1,959	2,428	1,399	760	189	9,924	6,102	0	16,026
1994	828	561	4,414	1,128	1,662	1,883	892	1,540	137	8,321	4,724	0	13,045
1995	293	696	1,737	1,586	1,306	1,032	510	1,528	79	5,349	3,418	0	8,767
1996	466	813	2,787	1,484	1,608	1,659	930	654	171	6,055	4,517	0	10,572
1997	453	837	2,213	1,327	1,793	2,240	1,070	1,303	183	5,943	5,479	0	11,422
1998	477	907	1,634	1,796	983	1,284	606	331	151	5,064	3,105	0	8,169
1999	397	584	1,548	1,288	956	778	408	111	121			0	6,190
2000	291	395	1,433	1,198	1,071	680	413	151	124	3,317	2,439	0	5,756
2001	257	535	1,049	1,395	985	814	441	125	106	3,236	2,471	0	5,707
2002	230	461	873	1,491	1,152	924	458	125	155	3,055	2,814	0	5,869
2003	24	189	97	720	379	681	119	44	30	1,030	1,253	0	2,283

Landings for 2003 include Jan 1-June 30 only.

Table 3. Nominal catch of 4X cod by month for Canada Maritimes vessels.

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Unknown	Total	Total[a]	TAC
1960	119	428	235	388	1,565	1,329	2,924	1,365	1,703	934	662	417	0	12,069		
1961	225	298	246	597	984	2,324	2,527	1,397	1,250	1,299	880	416	0	12,423		
1962	63	168	363	904	1,181	1,984	3,473	1,846	1,988	1,157	926	556	0	14,549		
1963	309	122	309	577	1,564	2,896	2,570	2,660	1,933	1,714	777	359	0	15,790		
1964	474	320	832	1,690	1,727	3,182	3,592	2,856	2,417	2,362	899	367	349	21,067		
1965	392	367	1,229	1,881	2,603	3,724	4,694	2,634	2,708	2,377	927	685	0	24,221		
1966	911	755	838	2,061	2,034	3,419	4,299	3,323	2,555	2,470	910	588	0	24,163		
1967	874	823	820	1,462	2,304	5,155	4,210	4,052	3,334	2,962	1,304	513	0	27,813		
1968	871	1,107	1,406	2,377	3,121	5,009	4,952	4,116	2,742	3,037	1,328	774	0	30,840		
1969	1,876	1,694	1,071	1,845	2,160	4,176	3,722	2,797	1,943	1,483	827	518	0	24,112		
1970	805	500	617	970	2,024	2,745	2,775	2,279	1,969	1,874	921	541	0	18,020		
1971	526	848	584	814	1,725	3,939	3,328	2,483	2,487	1,902	1,110	555	0	20,301		
1972	862	633	473	744	1,258	3,832	3,982	2871	2038	2663	925	250	0	20,531		
1973	1,009	925	514	1,056	1,381	3,919	2,937	2,623	2,264	1,544	818	1,001	0	19,991		
1974	771	397	399	695	1,335	3,583	3,150	2,538	1,968	1,765	877	1,464	0	18,942		
1975	648	169	394	712	3,223	3,250	3,355	2,647	1,796	1,457	668	1,267	0	19,586		
1976	363	555	376	581	1,220	2,824	2,869	2,064	1,968	1,390	782	1,140	0	16,141		
1977	580	940	861	1,580	2,232	3,782	3,366	2,444	1,740	2,046	1,443	973	0	21,989		
1978	862	2,042	911	1,371	1,987	3,411	3,379	2,920	2,454	1,473	1,085	1,828	0	23,723		
1979	889	752	1,973	1,400	1,846	4,276	3,638	3,555	3,218	2,233	2,992	1,935	0	28,707		
1980	706	2,188	1,704	2,485	3,317	5,316	3,433	3,346	2,603	2,876	1,547	1,756	0	31,277		
1981	1,649	2,451	2,529	1,533	2,881	4,093	3,845	4,067	2,253	3,119	1,728	1,373	0	31,521		
1982	757	2,390	2,569	1,491	3,415	5,109	4,734	3,258	3,540	2,890	1,244	1,737	0	33,134		30,000
1983	1,713	1,654	1,648	1,888	2,743	5,713	4,554	2,832	3,183	1,787	1,037	719	0	29,471		30,000
1984	1,798	2,021	752	817	1,796	3,471	3,688	4,567	2,773	1,668	1,201	976	0	25,528		30,000
1985	779	1,699	956	1,268	1,974	2,586	3,199	2,650	2,737	1,801	787	1,063	0	21,499		30,000
1986	904	1,633	1,775	1,450	1,437	1,939	2,739	1,995	2,576	1,714	771	1,107	0	20,040		20,000
1987	1,208	1,837	1,242	1,059	1,870	2,778	2,663	1,821	1,679	1,403	910	535	0	19,005		18,000
1988	2,104	1,531	535	939	1,620	2,931	3,104	2,122	2,524	1,441	636	1,050	0	20,537		16,000
1989	2,150	2,347	1,362	1,707	1,292	3,562	1,830	1,772	1,535	1,278	637	413	0	19,885		13,000
1990	2,619	2,027	707	778	1,560	3,104	3,751	3,123	2,598	1,689	1,158	790	0	23,904		22,000
1991	2,023	2,651	993	1,666	2,322	3,167	3,963	2,881	2,967	2,208	1,650	1,258	0	27,749		26,000
1992	2,088	1,740	1,297	1,502	1,685	3,622	3,366	2,803	2,625	2,353	1,478	1,521	0	26,080		26,000
1993	657	903	994	996	1,617	2,312	2,834	2,221	1,804	1,048	562	78	0	16,026		16,000
1994	734	972	547	847	824	1,771	2,246	1,503	1,267	1,154	726	454	0	13,045		14,000
1995	610	229	317	827	574	1,236	1,771	774	1,071	521	276	561	0	8,767		9,000
1996	503	331	446	531	819	1,755	1,805	1,317	880	887	679	619	0	10,572		11,000
1997	98	362	378	806	644	1,440	1,779	1,382	1,548	1,424	710	668	0	11,239		13,000
1998	285	348	402	313	511	941	1,272	953	1,125	770	520	729	0	8,169		9,300
1999	186	105	124	330	414	1,047	1,269	856	854	445	324	235	0	6,190	7,216	7,910
2000	215	255	556	113	368	906	1,104	755	545	507	324	107	0	5,755	5,834	6000*
2001	361	103	641	315	449	745	870	672	594	470	318	169	0	5,707	5,908	6,000
2002	376	274	561	624	493	673	837	742	563	358	229	141	0	5,869	5,729	6,000
2003	295	160	684	288	474	375	7							2,283	1,144	6,000

[a] Total landings for quota year: Jan 1, 1998-Apr. 1, 1999; Apr. 1 – Mar. 31 thereafter

Table 4. Number of fishing vessels reporting cod landings annually.

Year	Otter trawl	Gill net	Longline	Handline
1996	142	205	528	779
1997	142	197	497	657
1998	129	163	398	422
1999	129	126	357	354
2000	121	101	376	326
2001	112	97	366	201
2002	113	110	381	162

Table 5. Groundfish fishing days by gear type in 4X.

Year	Gill net	Longline	Handline
1996	4,912	5,210	9,880
1997	6,281	6,179	9,650
1998	4,178	5,352	5,721
1999	3,370	4,156	4,234
2000	2,321	3,794	3,287
2001	2,116	3,895	2,093
2002	2,211	4,172	1,351

Table 6. Level of observer coverage in cod/haddock directed fisheries in 4X.

Year		Otter trawl Tonnage	Otter trawl proportion	Longline Tonnage	Longline proportion
2001	observed	45.4	3.80%	11.1	0.74%
	landed	1188		1500	
2002	observed	0.3	0.01%	6.3	0.30%
	landed	1777		1867	
2003	observed	10.5	0.85%	6.9	0.82%
	landed	1233		842	

Table 7a. Construction of length frequencies for 4X cod for 2002, and age-length keys against which they are matched.

Gear	Quarter	Area	a	b	Number of samples	Number Measured	Landings (t)	ALK used
OT	1	Fundy	0.0081	3.0503	7	1,451	459	Q1 Bay
GN					0	Q2 Bay GN[a]	34	Q1 Bay
LL					0	Q1 Bay OT[a]	7	Q1 Bay
HL					0	0	0	
OT	1	4Xmno			4	696	71	Q1 mno
GN					0	Q3 mno GN[a]	3	Q1 mno
LL					7	1,661	148	Q1 mno
HL					0	0	0	
OT	1	4Xp			6	1,372	421	Q1 p
GN					3	755	67	Q1 p
LL					1	247	2	Q1 p
HL					0	0	0	
OT	2	Fundy	0.0084	3.0410	12	3,038	768	Q2 Bay
GN					4	713	128	Q2 Bay
LL					1	280	134	Q2 Bay
HL					1	264	59	Q2 Bay
OT	2	4Xmno			1	253	49	Q2 mno
GN					0	Q3 mno GN[a]	12	Q2 mno
LL					2	593	65	Q2 mno
HL					4	672	74	Q2 mno
OT	2	4Xp			2	433	145	Q2 p
GN					4	975	279	Q2 p
LL					0	Q3 p LL[a]	51	Q2 p
HL					0	Q2 mno HL[a]	13	Q2 p
OT	3	Fundy	0.0087	3.0233	4	588	305	Q4 Q3 Bay
GN					3	386	356	Q3 Bay
LL					2	254	127	Q3 Bay
HL					1	111	61	Q3 Bay
OT	3	4Xmno			1	276	15	Q3 mno
GN					1	270	78	Q3 mno
LL					5	1,183	666	Q3 mno
HL					2	304	56	Q3 mno
OT	3	4Xp			4	741	75	Q3 p
GN					0	Q2 p GN[a]	34	Q3 p
LL					4	689	284	Q3 p
HL					0	Q3 mno HL[a]	8	Q3 p
OT	4	Fundy	0.0063	3.1152	8	1,578	227	Q4 Q3 Bay
GN					0	Q3 Bay GN[a]	16	Q4 Bay
LL					1	270	5	Q4 Bay
HL					0	Q3 Bay HL[a]	2	Q4 Bay
OT	4	4Xmno			0	Q3 mno OT[a]	8	Q4 mno
GN					0	Q3 mno GN[a]	16	Q4 mno
LL					7	557	5	Q4 mno
HL					0	Q3 mno HL[a]	2	Q4 mno
OT	4	4Xp			4	831	44	Q4 p
GN					2	239	15	Q4 p
LL					5	1187	55	Q4 p
HL					0	0	0	Q4 p

[a]LF substituted due to absence of commercial sampling for this gear/area/quarter combination

Table 7b. Construction of length frequencies for 4X cod for 2003, and age-length keys against which they are matched.

Gear	Quarter	Area	a	b	Number of samples	Number Measured	Landings (t)	ALK used
OT	1	Fundy	0.0081	3.0503	6	1,433	449	Q1_Bay
GN					0	Q2_Bay_GN#	4	Q1_Bay
LL					0	Q2_Bay_LL#	9	Q1_Bay
HL					0	0	0	Q1_Bay
OT	1	4Xmno			2	456	62	Q1_mno
GN					0	Q1_p_GN#	0	Q1_mno
LL					6	1,555	157	Q1_mno
HL					0	0	0	Q1_mno
OT	1	4Xp			7	1,537	298	Q1_p
GN					1	83	144	Q1_p
LL					0	Q2_p_LL#	12	Q1_p
HL					0	0	0	Q1_p
OT	2	Fundy	0.0084	3.0410	11	1,930	564	Q2_Bay
GN					2	340	61	Q2_Bay
LL					2	222	91	Q2_Bay
HL					0	Q2_Bay_LL#	27	Q2_Bay
OT	2	4Xmno			0	Q2_mno_LL#	17	Q2_mno
GN					0	Q2_p_GN#	6	Q2_mno
LL					2	479	52	Q2_mno
HL					3	418	14	Q2_mno
OT	2	4Xp			4	853	67	Q2_p
GN					7	909	147	Q2_p
LL					4	272	51	Q2_p
HL					0	Q2_mno_HL#	1	Q2_p

Length frequency substituted due to lack of commercial sampling for this gear/area/quarter combination

Table 8. Catch at age (number in thousands) for cod in Division 4X.

Age	1	2	3	4	5	6	7	8	9	10	11	12	13	2+	3+	4+
1980	0	837	6,054	2,358	1,742	1,135	442	261	91	60	19	17	5	13,021	12,183	6,129
1981	0	818	3,870	4,265	1,844	1,045	587	297	184	75	39	19	19	13,061	12,244	8,373
1982	0	904	2,885	4,414	3,060	912	393	279	146	86	41	25	15	13,160	12,255	9,371
1983	9	1,031	3,689	2,433	2,057	1,205	459	204	120	76	36	10	10	11,330	10,299	6,610
1984	33	917	2,393	3,081	1,930	965	465	176	63	49	29	18	5	10,090	9,173	6,781
1985	0	711	1,674	1,569	2,324	1,284	514	194	71	53	18	7	6	8,425	7,715	6,041
1986	0	251	2,789	1,941	994	1,008	409	200	93	50	23	20	10	7,788	7,537	4,748
1987	0	861	902	2,053	1,087	523	511	236	140	66	33	9	7	6,428	5,567	4,665
1988	0	403	3,517	1,659	1,553	656	178	192	85	53	28	6	9	8,338	7,935	4,418
1989	17	655	2,560	3,656	632	562	163	79	60	19	10	10	2	8,408	7,753	5,193
1990	0	144	2,863	2,805	2,462	497	279	78	40	38	14	15	1	9,235	9,091	6,228
1991	2	391	1,535	5,092	1,777	1,364	215	156	32	16	28	15	6	10,626	10,235	8,700
1992	0	751	3,391	1,878	3,276	878	513	63	50	16	9	4	0	10,828	10,077	6,685
1993	0	881	3,490	2,045	660	672	186	90	14	14	5	0	0	8,056	7,176	3,686
1994	0	475	2,280	2,233	887	195	181	42	18	0	2	0	0	6,314	5,838	3,558
1995	0	135	2,146	1,081	582	130	28	40	11	5	0	0	0	4,158	4,023	1,877
1996	0	50	883	2,594	441	212	29	16	8	2	1	1	0	4,237	4,187	3,304
1997	0	59	1,126	1,556	1,193	199	82	16	2	6	1	3	0	4,243	4,184	3,058
1998	0	234	886	1,021	615	441	54	20	6	2	3	1	1	3,284	3,050	2,164
1999	0	72	834	543	347	264	120	20	7	0	0	1	0	2,210	2,138	1,303
2000	0	218	575	905	247	189	66	27	8	1	1	0	0	2,237	2,019	1,444
2001	0	114	1,187	595	378	75	40	17	12	1	0	0	0	2,420	2,306	1,119
2002		29	435	1,035	245	142	28	16	10	2	1	0	0	1,942	1,913	1,478
2003*		5	114	272	234	44	31	8	1	1	1	0	0	710	705	591

*2280t landed for 2003 by June 30; expected landings for the full year are 6000t.

Table 9. Weights at age for cod in 4X by region

		1	2	3	4	5	6	7	8	9	10	11	12
	1983		0.76	1.22	1.81	2.50	3.93	6.09	8.22	10.76	11.83	12.22	16.59
	1984		0.96	1.30	1.69	2.34	3.37	4.68	6.83	8.60	11.06	13.21	14.03
	1985		0.60	1.07	1.47	2.00	3.06	4.55	6.70	6.89	9.00	14.16	15.66
	1986		0.78	1.13	1.63	2.21	3.47	4.69	7.15	8.83	8.81	13.11	13.10
	1987		1.23	1.40	1.83	2.61	3.46	4.99	7.33	8.36	10.66	11.80	15.85
Scotian	1988		0.94	1.30	1.90	2.69	3.98	5.23	8.06	9.88	10.93	13.05	16.04
Shelf	1989	0.78	1.23	1.57	2.21	2.75	3.96	4.88	7.86	9.46	11.95	15.04	14.81
	1990		0.82	1.29	1.97	2.86	3.72	5.59	8.10	10.46	11.93	14.12	15.24
	1991		0.76	1.13	1.73	2.50	3.54	5.08	6.44	9.44	11.19	13.73	15.74
	1992		0.78	1.14	1.63	2.58	3.58	4.44	6.50	8.37	12.10	14.50	19.15
	1993		0.68	1.25	1.62	2.24	3.44	4.67	7.01	9.13	10.97	18.08	
	1994		0.76	1.04	1.92	2.41	3.15	4.97	5.21	9.28	15.98	13.56	
	1995		0.86	1.23	1.72	3.26	4.09	4.69	7.23	9.18	13.33	16.33	
	1996		0.75	1.21	2.06	2.96	4.77	5.53	6.39	9.80	12.02	10.12	
	1997		1.17	1.22	1.83	3.31	4.49	6.04	8.83	9.99	11.14	13.58	8.71
	1998		0.86	1.12	1.71	2.54	4.42	4.72	7.33	9.76	9.66	10.83	16.17
	1999		1.00	1.71	2.32	2.83	4.03	5.43	8.26	10.70	13.24	11.35	16.54
	2000		0.93	1.50	2.32	2.85	3.14	4.05	5.57	4.33	6.74	10.25	12.53
	2001		0.99	1.62	2.19	3.65	4.11	5.12	6.62	8.19	8.72	11.05	0.00
	2002		0.75	1.29	2.39	3.08	4.55	5.70	7.24	7.32	8.54	7.61	
	2003*		0.90	1.45	2.02	3.70	5.23	5.90	5.76	9.74	11.15	12.89	
	Mean	0.78	0.88	1.29	1.90	2.76	3.88	5.10	7.08	8.97	11.00	12.88	14.01
	1983	0.38	0.86	1.48	2.18	3.30	4.88	6.38	8.62	9.92	12.19	14.23	20.63
	1984	0.39	0.93	1.62	2.48	3.52	4.67	6.98	7.94	12.10	13.45	4.75	
	1985	0.37	0.84	1.48	2.26	3.43	4.53	6.54	9.45	11.46	15.12	18.23	19.52
	1986	0.37	0.80	1.41	2.33	4.30	6.24	7.36	8.18	9.50	14.25	7.99	11.98
	1987		0.84	1.57	2.56	4.17	5.33	7.04	7.92	7.94	14.31	18.56	
Bay of	1988		0.86	1.46	2.24	4.09	5.36	8.99	10.14	8.89	14.69		
Fundy	1989	0.33	0.76	1.52	2.59	3.60	6.33	7.25	10.32	10.55	14.57		11.66
	1990		1.05	1.69	2.69	3.77	4.37	7.31	8.15	11.32	11.95	12.75	14.74
	1991	0.82	1.04	1.88	2.91	4.26	6.77	8.75	11.02	13.60	14.17	15.10	17.93
	1992		1.18	1.73	2.73	4.49	6.51	8.78	9.93	13.13	14.55	11.10	
	1993		0.90	1.74	2.86	4.74	6.09	7.58	9.18	14.32	16.75	13.85	
	1994		0.98	1.75	3.19	5.72	7.96	9.31	11.61	11.56		17.46	
	1995		1.29	1.91	2.78	4.38	6.01	7.76	9.84	12.49	8.57	14.32	
	1996		1.06	1.70	2.85	4.71	6.12	5.97	10.56	11.05			13.19
	1997		1.17	1.73	2.74	4.28	5.77	8.44	10.30	9.18	12.94	11.07	22.55
	1998		1.16	1.99	3.14	4.49	5.91	8.13	9.20	12.75		14.32	
	1999	0.70	1.31	1.88	2.93	4.44	6.06	7.55	4.43			8.97	14.78
	2000		1.28	2.17	3.49	3.96	5.66	7.80	8.65	11.44	13.67	10.59	11.55
	2001		0.95	2.01	3.46	4.72	6.36	8.15	8.42	11.41	11.88		
	2002		1.33	2.15	3.51	5.27	7.04	8.14	10.13	12.03	18.09		
	2003*		0.67	1.79	2.69	4.05	5.66	8.32	9.18	8.78		19.68	
	Mean	0.48	1.01	1.74	2.79	4.27	5.89	7.74	9.20	11.17	13.82	13.31	15.85

*Mean weight at age from landings for January 1-June 30, 2003

Table 10a. RV survey stratified numbers for cod in 4X.

Age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	208	141	1085	4226	2369	1480	946	389	0	77	37	0	6
1984	0	820	5746	3390	2362	1820	688	482	63	58	25	0	0
1985	69	495	8760	4331	1527	1451	766	483	267	165	13	0	26
1986	25	768	1333	2920	1226	314	549	448	217	97	19	0	51
1987	6	392	2348	618	1180	528	260	245	304	75	40	63	0
1988	260	2630	3926	9246	1496	1548	496	210	244	91	38	13	0
1989	309	794	6089	3420	2549	420	489	108	27	82	37	14	0
1990	28	515	873	5523	2463	2321	240	414	80	42	0	21	27
1991	34	614	1727	1131	3086	1094	751	128	116	19	21	12	0
1992	35	252	2731	1569	681	1710	471	460	124	85	0	0	0
1993	14	369	955	2518	925	129	265	52	61	0	6	41	0
1994	748	1258	3313	2739	1605	449	36	195	88	70	0	32	65
1995	1212	122	847	4779	1477	598	274	94	91	34	42	7	0
1996	31	339	839	2048	5527	880	753	148	0	56	15	0	0
1997	95	349	569	1189	1444	2462	321	194	100	0	57	0	0
1998	65	211	1929	1808	1418	1022	1371	225	116	6	0	0	0
1999	869	382	787	1291	882	850	194	297	46	0	0	0	0
2000	3324	432	1497	830	999	409	325	157	148	0	0	0	21
2001	908	150	1984	2272	1476	816	347	217	148	31	0	0	0
2002	110	5196	1990	2565	2472	496	302	121	19	98	0	0	0
2003	715	499	3005	544	1102	745	189	78	20	19	0	0	0

Table 10b. RV survey stratified numbers for cod in the Bay of Fundy.

age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	71	34	514	1069	456	543	400	244	0	63	37	0	0
1984	0	466	4328	2015	1161	313	150	66	63	23	25	0	0
1985	0	404	7923	3497	1184	995	283	169	190	165	0	0	0
1986	25	749	718	1974	717	163	114	99	21	97	0	0	0
1987	0	313	1118	313	855	278	154	177	117	49	40	63	0
1988	233	1837	2323	4103	179	661	268	103	187	0	0	0	0
1989	9	658	3179	1632	826	190	262	20	27	52	19	0	0
1990	0	364	660	3335	1044	1002	128	306	80	42	0	21	21
1991	0	466	620	532	1253	372	206	48	109	0	21	12	0
1992	0	144	2184	588	322	765	66	237	21	56	0	0	0
1993	0	336	659	1854	423	49	183	20	0	0	0	0	0
1994	657	878	2240	2113	996	180	16	143	38	20	0	32	32
1995	996	89	313	2671	418	351	45	47	60	0	42	0	0
1996	0	132	465	740	3149	578	324	0	0	32	0	0	0
1997	65	223	170	629	594	1236	194	85	0	0	31	0	0
1998	26	211	1488	1209	923	465	868	128	61	0	0	0	0
1999	192	313	457	561	207	115	29	199	46	0	0	0	0
2000	61	346	1346	585	734	179	102	12	0	0	0	0	0
2001	1262	0	567	1449	474	240	22	0	0	0	0	0	0
2002	0	4269	1743	2143	1954	214	183	73	19	73	0	0	0
2003	457	488	2771	334	875	601	174	49	20	19	0	0	0

Table 10c. RV survey stratified numbers for cod on the Scotian Shelf in 4X.

Age	0	1	2	3	4	5	6	7	8	9	10	11	12+
1983	136	107	571	3157	1914	937	546	146	0	13	0	0	6
1984	0	354	1417	1376	1201	1507	538	416	0	36	0	0	0
1985	69	90	837	834	343	456	483	314	77	0	13	0	26
1986	0	19	616	947	509	151	435	349	195	0	19	0	51
1987	6	79	1229	305	325	250	106	68	187	26	0	0	0
1988	27	793	1602	5143	1317	887	228	107	57	91	38	13	0
1989	301	136	2910	1789	1723	230	227	89	0	30	18	14	0
1990	28	151	213	2187	1419	1319	113	108	0	0	0	0	7
1991	34	147	1107	599	1833	722	545	80	7	19	0	0	0
1992	35	108	547	981	359	946	405	224	104	29	0	0	0
1993	14	33	296	664	502	80	82	32	61	0	6	41	0
1994	92	380	1073	626	610	268	19	51	50	50	0	0	33
1995	216	33	534	2107	1059	248	229	47	32	34	0	7	0
1996	31	207	374	1307	2378	303	429	148	0	24	15	0	0
1997	30	126	399	560	850	1225	128	109	100	0	26	0	0
1998	39	0	441	599	495	557	503	97	55	6	0	0	0
1999	677	69	330	730	675	736	165	98	0	0	0	0	0
2000	3263	86	151	246	265	230	223	144	148	0	0	0	21
2001	908	150	487	1441	477	406	22	60	0	31	0	0	0
2002	110	59	247	430	547	306	141	49	0	25	0	0	0
2003	258	11	234	210	227	144	15	30	0	0	0	0	0

Table 11. ITQ survey indices for cod in Division 4X and divided into Fundy and Shelf regions.

4X	0	1	2	3	4	5	6	7	8	9	10	11
1996	1	302	662	835	737	84	31	6	0	2	0	1
1997	1	225	232	727	393	265	17	24	6	2	1	0
1998	16	179	857	619	276	112	112	15	7	0	0	0
1999	8750	601	700	708	170	98	15	24	5	1	0	0
2000	5	1063	1039	351	234	62	61	15	13	0	0	0
2001	907	234	2369	3391	382	142	5	21	5	6	0	0
2002	37	380	551	510	343	63	35	21	2	4	0	0
2003	37	283	1099	551	322	167	36	12	4	1	0	0

FUNDY	0	1	2	3	4	5	6	7	8	9
1996	1	259	487	359	427	61	13	1	0	1
1997	0	207	126	529	204	182	10	17	5	1
1998	16	150	754	493	186	40	69	4	1	0
1999	8748	506	412	526	92	50	8	22	5	0
2000	3	955	738	156	135	21	6	4	4	0
2001	907	115	2120	3196	298	83	2	5	0	0
2002	35	343	97	277	253	25	20	17	2	0
2003	36	278	771	133	213	137	32	9	2	0

Shelf	0	1	2	3	4	5	6	7	8	9	10	11
1996	0	43	175	476	310	23	17	5	0	1	0	1
1997	1	18	106	198	189	83	7	7	1	1	1	0
1998	0	29	103	126	89	71	44	11	6	0	0	0
1999	2	95	287	182	78	48	7	2	0	1	0	0
2000	2	108	301	196	98	42	55	11	9	0	0	0
2001	0	119	249	195	84	59	3	16	5	6	0	0
2002	2	37	454	233	89	39	14	4	0	4	0	0
2003	1	5	328	418	109	30	3	3	2	1	0	0

Table 12. Cod and haddock landings by month and unit area for otter trawl in 4X

		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec	total
	cod						0	0				1	0	1
4Xm	haddock						0	0				2	0	2
	had/cod						0.00	1.27				1.57	22.00	1.58
	cod	6	32	13	11	1	3	0		0		0	1	67
4Xn	haddock	107	298	286	368	0	5	0		2		2	1	1070
	had/cod	17.43	9.33	21.62	34.23	0.83	1.70	3.75		3.41		5.73	1.41	15.89
	cod	9	2	0	1	13	6	3	1	0	1	0	0	36
4Xo	haddock	142	21	4	0	1	6	5	2	1	2	1	1	187
	had/cod	15.15	9.25	22.51	0.41	0.11	1.07	2.18	4.24	14.32	1.42	7.01	10.48	5.20
	cod	60	36	162	62	2	6	15	19	16	10	10	10	408
4Xp	haddock	42	130	129	34	0	40	151	168	143	114	54	45	1048
	had/cod	0.70	3.59	0.80	0.54	0.18	7.03	10.29	8.85	9.10	10.89	5.70	4.30	2.57
	cod	3	7	96	77	77	40	2	0	0	0	6	12	317
4Xq	haddock	4	5	75	62	96	34	2	2	12	1	0	21	313
	had/cod	1.35	0.69	0.77	0.81	1.24	0.84	0.93	4.21	27.88	3.93	0.20	1.73	0.99
	cod	152	47	67	64	106	56	22	10	15	37	37	45	660
4Xr	haddock	447	42	13	16	104	146	65	22	42	46	76	126	1143
	had/cod	2.94	0.89	0.19	0.25	0.96	2.61	2.91	2.15	2.82	1.24	2.02	2.81	1.73
	cod	1	1	2	3	14	51	47	68	48	31	15	15	295
4Xs	haddock	3	1	1	0	27	170	208	210	180	96	47	69	1010
	had/cod	2.99	0.50	0.24	0.14	2.01	3.35	4.46	3.08	3.74	3.06	3.15	4.58	3.42
	cod	232	125	341	218	217	161	90	98	80	79	64	84	1788
Total	haddock	745	496	507	480	231	400	434	401	379	257	182	264	4777
	had/cod	3.22	3.96	1.49	2.20	1.07	2.48	4.85	4.10	4.76	3.24	2.85	3.15	2.67

Table 13. Longline landings by area and season in 4X; winter is January-April and November-December, summer is May-October

Months 1,2,3,4,11,12, 2002			
area	cod (t)	had (t)	ratio
m	140	157	1.12
n	190	279	1.47
op offshore	71	174	2.45
op coastal	29	10	0.35
q	106	56	0.53
r	88	32	0.36
s	7	2	0.28
u	70	52	0.75
Total	701	764	1.09

Months 5,6,7,8,9,10 2002			
area	cod (t)	had (t)	ratio
m	43	42	0.98
n	181	501	2.77
o,p offshore	610	762	1.25
o,p coastal	310	144	0.46
q	5	16	3.18
r	13	2	0.18
s	51	0	0.01
u	21	18	0.88
Total	1233	1485	1.20

2001			
area	cod (t)	had (t)	ratio
m	55	82	1.50
n	184	661	3.60
o,p offshore	73	120	1.66
o,p coastal	27	25	0.93
q	0	0	0.78
r	9	5	0.62
s	30	2	0.08
u	5	20	4.05
Total	381	915	2.40

2001			
area	cod (t)	had (t)	ratio
m	119	123	1.03
n	214	269	1.26
o,p offshore	669	576	0.86
o,p coastal	371	240	0.65
q	88	35	0.39
r	111	24	0.22
s	11	3	0.25
u	90	45	0.50
Total	1673	1314	0.79

2000			
area	cod (t)	had (t)	ratio
m	44	56	1.27
n	155	700	4.52
o,p offshore	58	143	2.44
o,p coastal	54	43	0.80
q	5	1	0.27
r	11	6	0.54
s	16	1	0.04
u	7	13	2.03
Total	351	963	2.75

2000			
area	cod (t)	had (t)	ratio
m	135	146	1.08
n	167	203	1.21
o,p offshore	699	806	1.15
o,p coastal	486	395	0.81
q	58	42	0.73
r	59	34	0.58
s	7	2	0.30
u	92	76	0.82
Total	1703	1704	1.00

Figure 1. Canadian statistical unit areas in Division 4X .

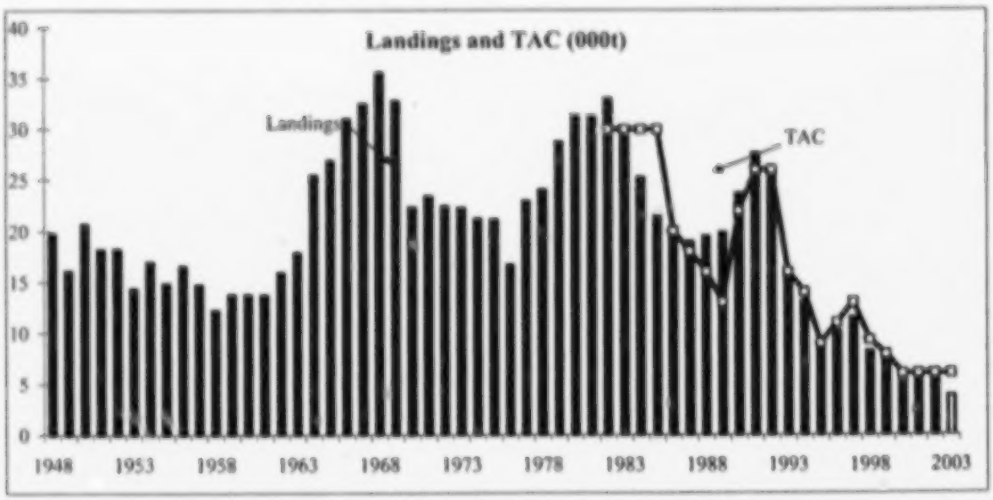

Figure 2. Nominal landings of cod in Division 4X and Canadian portions of 5Y.

Figure 1. Canadian statistical unit areas in Division 4X .

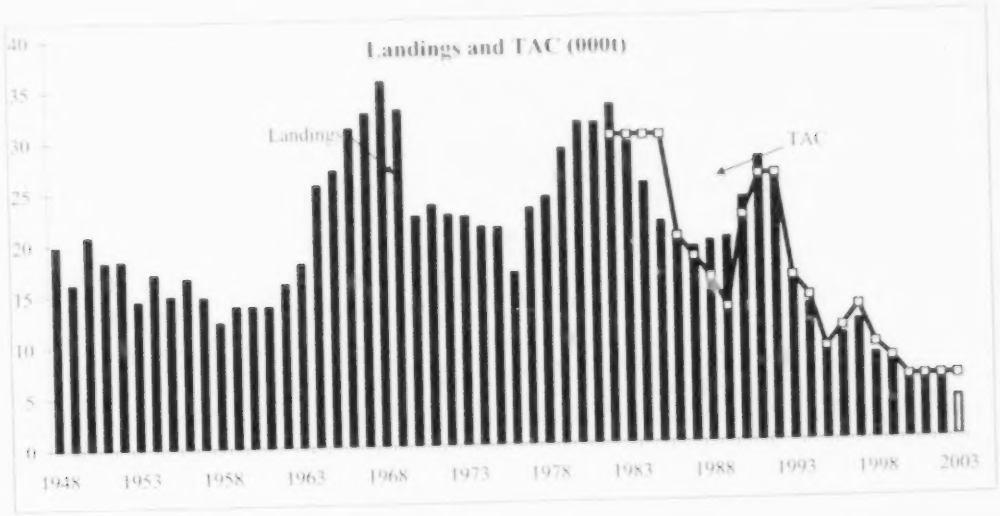

Figure 2. Nominal landings of cod in Division 4X and Canadian portions of 5Y.

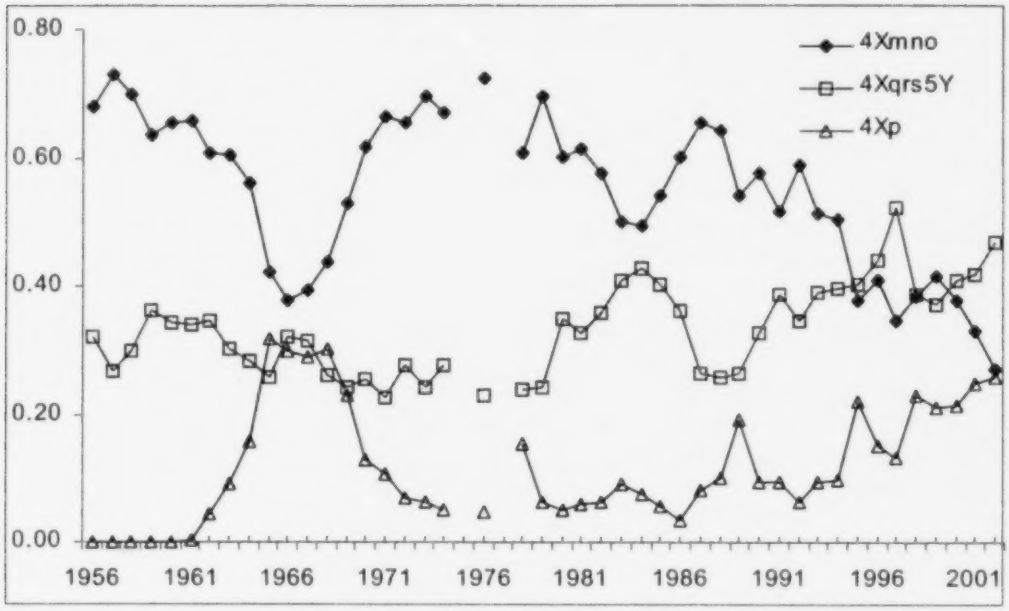

Figure 3. Proportion of cod landings by region in 4X.

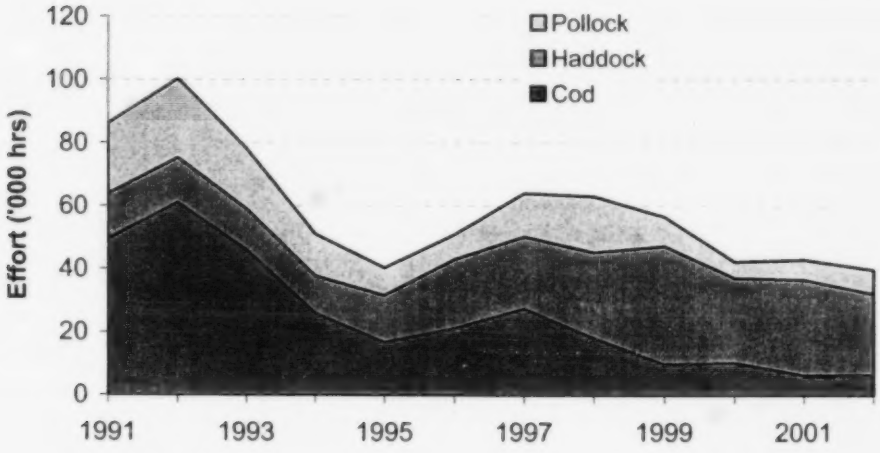

Figure 4. Fishing effort in 4X for the small dragger fleet where the main species caught was cod, haddock or pollock.

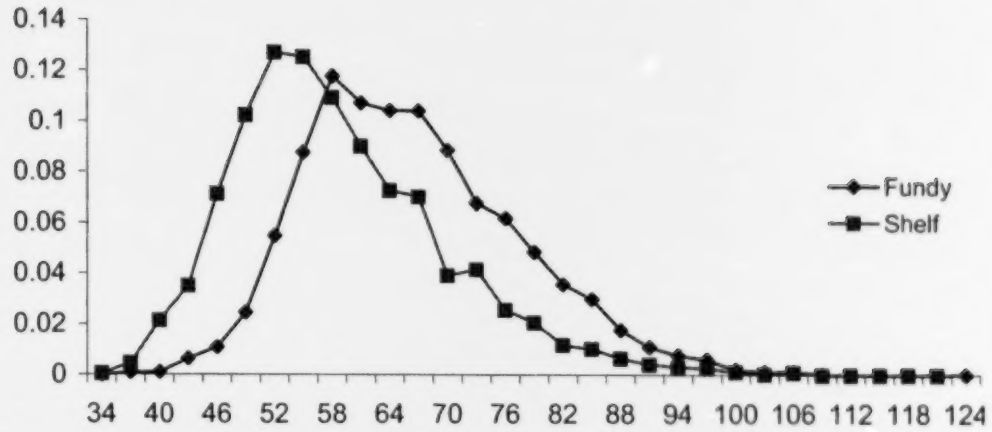

Figure 5. Proportion at length (cm) in commercial landings of 4X cod by area in 2003 (Jan.-July).

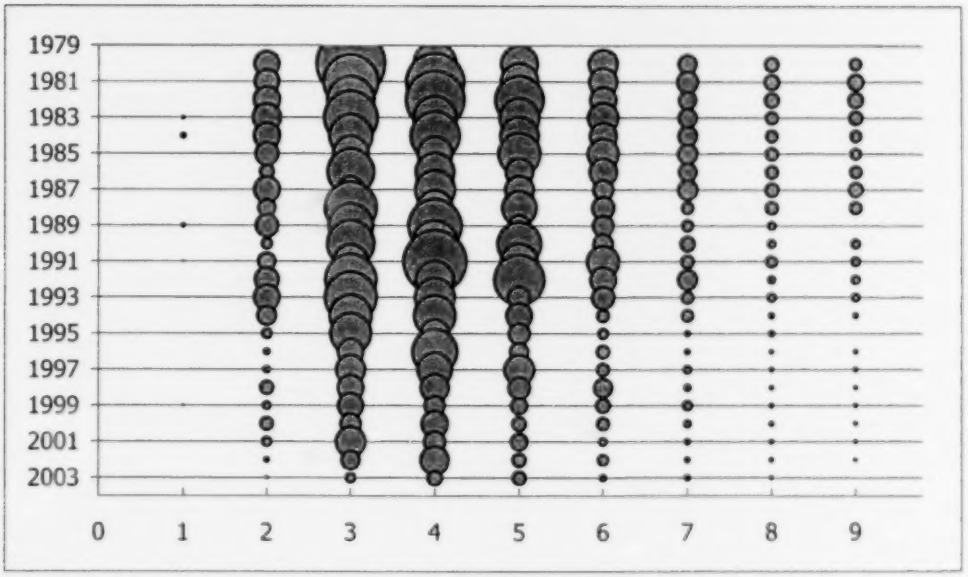

Figure 6. Catch at age for 4X cod; circle sizes are proportional to landed numbers (2003 landings for Jan. 1–July 1.)

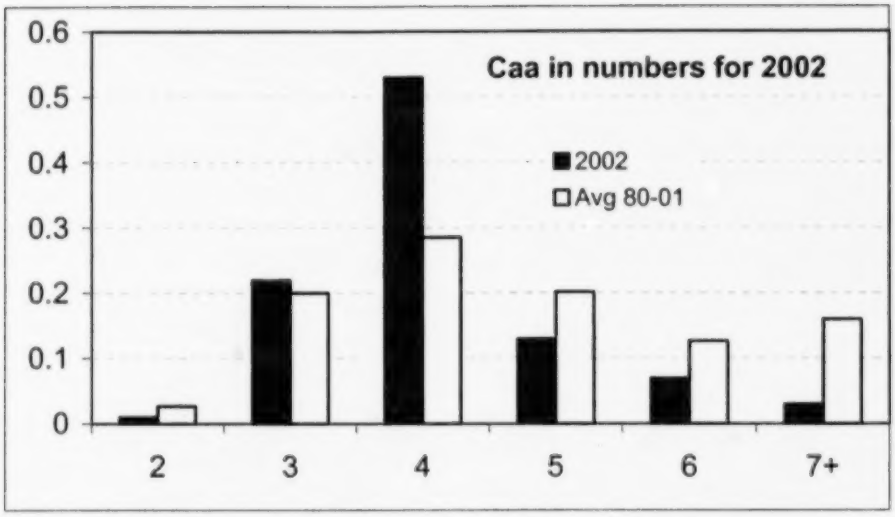

Figure 7. Proportional age composition for landings of 4X cod (numbers of fish) for 2002 compared to the average.

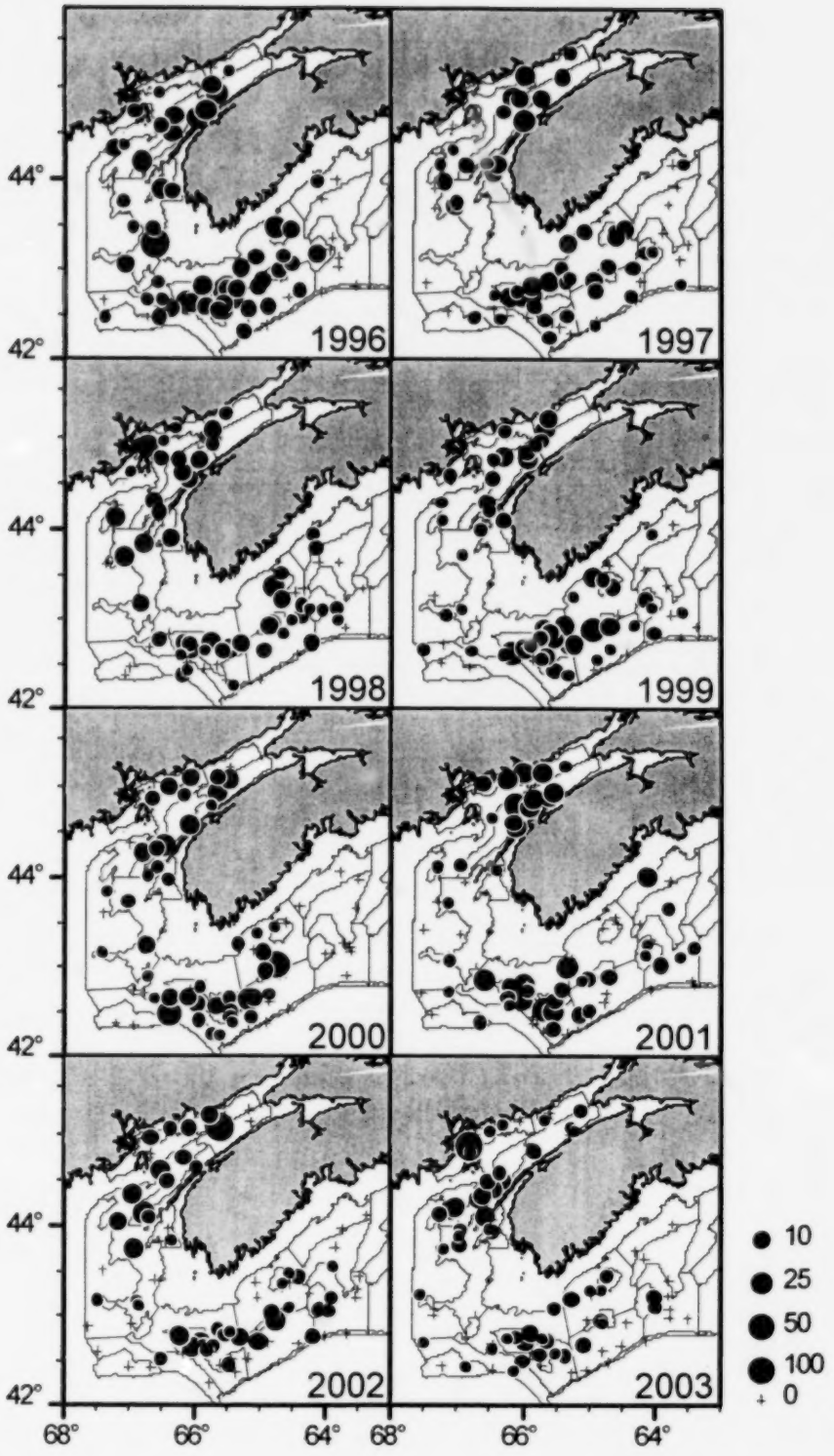

Figure 8. Distribution and magnitude of RV survey 4X cod catches (Kg)

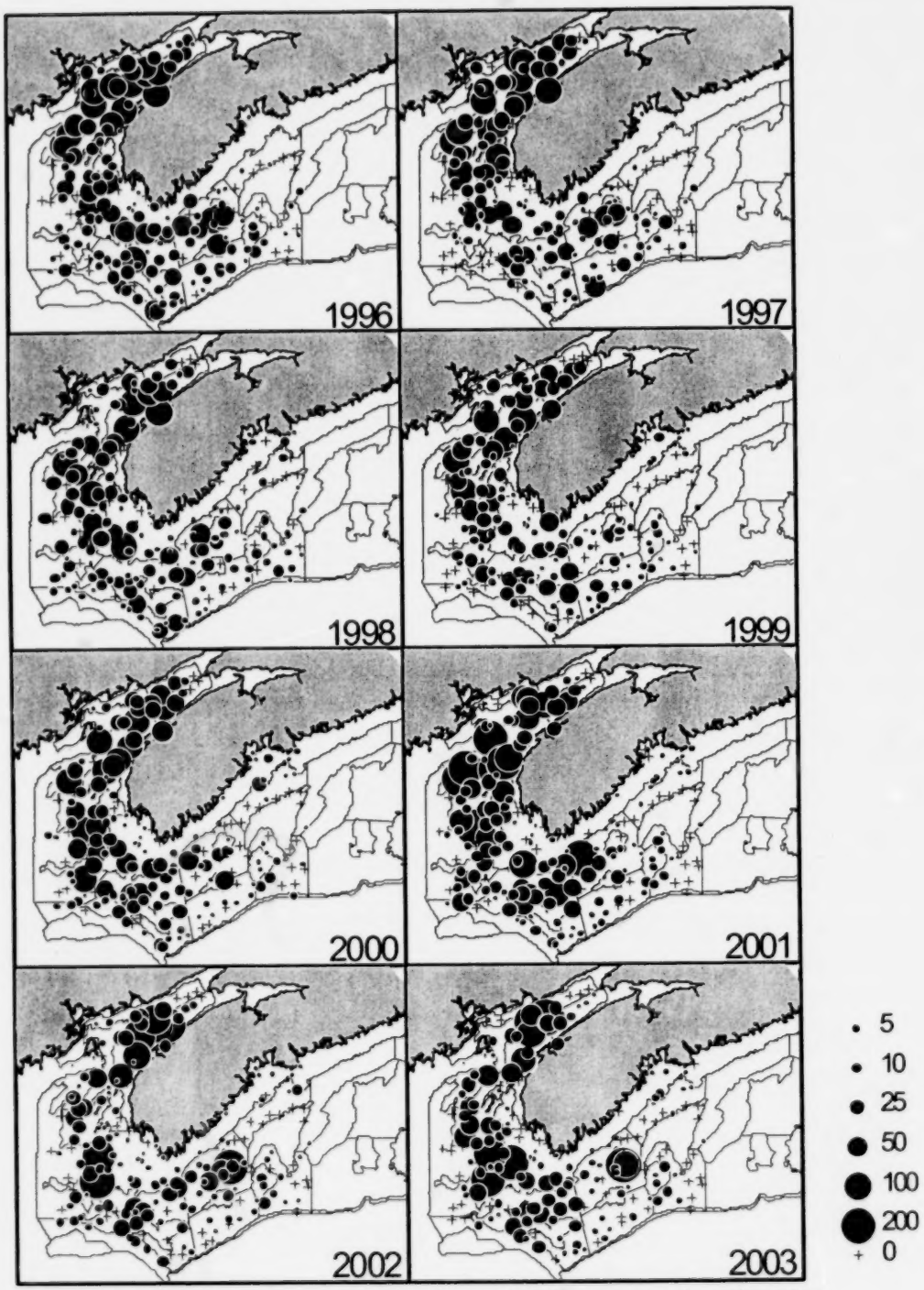

Figure 9. Distribution and magnitude of annual ITQ survey cod catches (Kg).

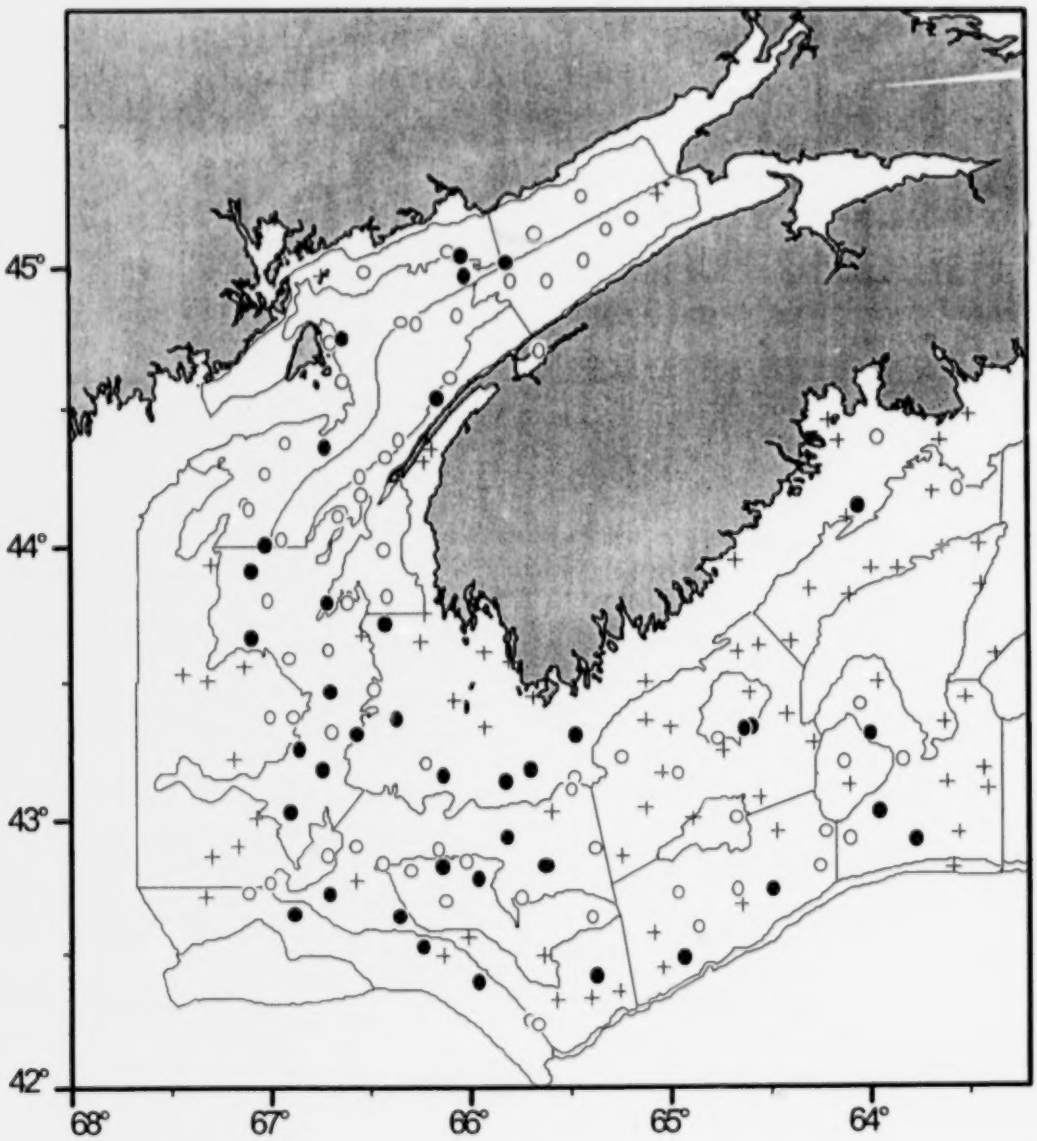

Figure 10. A comparison of ITQ survey cod catches for 2003 with the median value for each station since 1996. • 2003 value>median; + 2003 value is within 1 of the median; o 2003 value<median

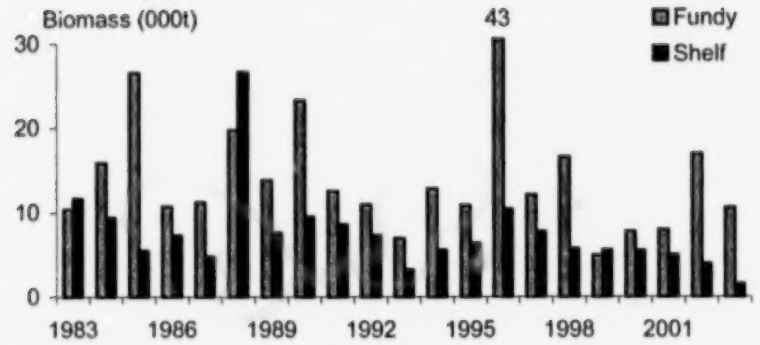

Figure 11. Survey biomass estimates by region for 4X cod.

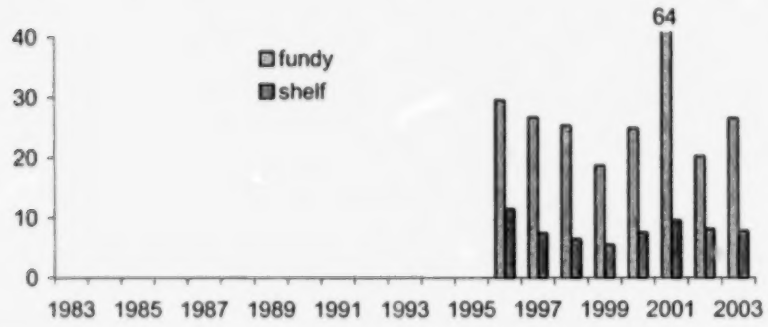

Figure 12. ITQ survey cod catch (Kg) by region.

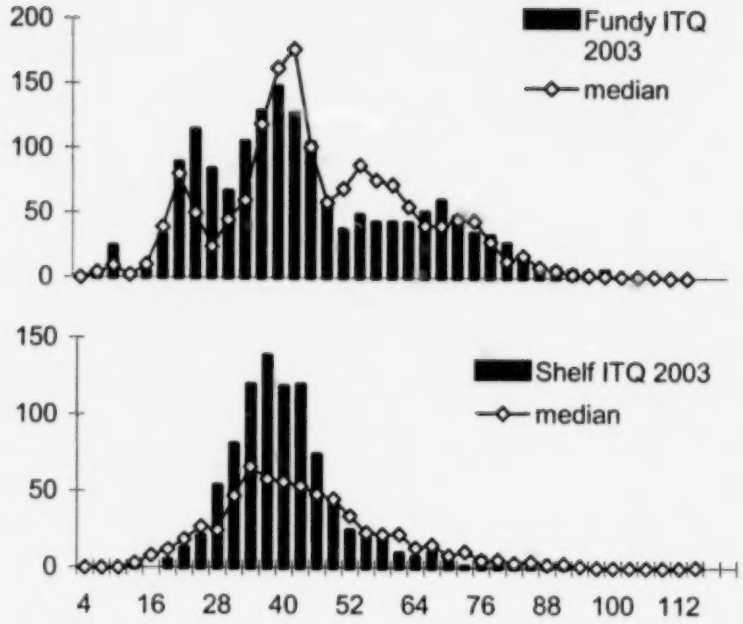

Figure 13. Length frequencies (cm) for 4X cod caught in the 2003 ITQ survey compared to the series medians.

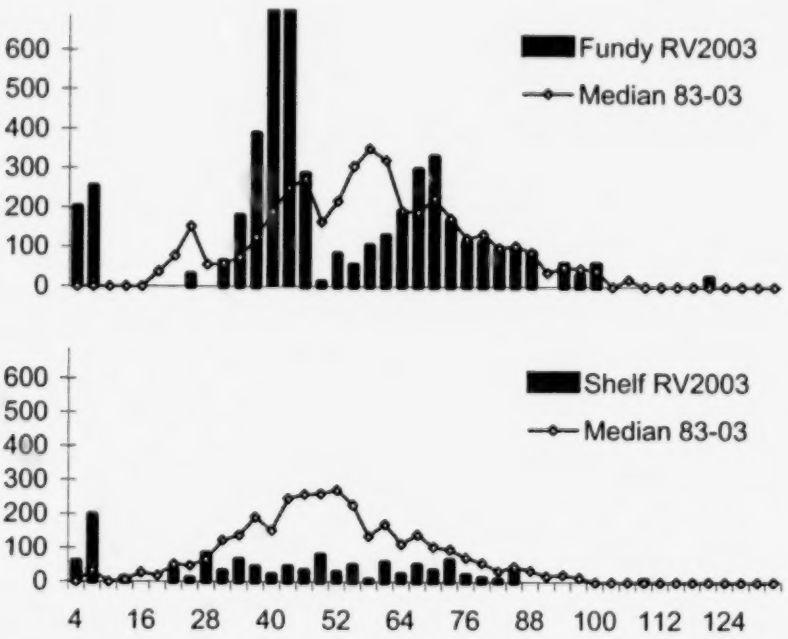

Figure 14. Length frequencies (cm) for 4X cod caught in the 2003 RV survey.

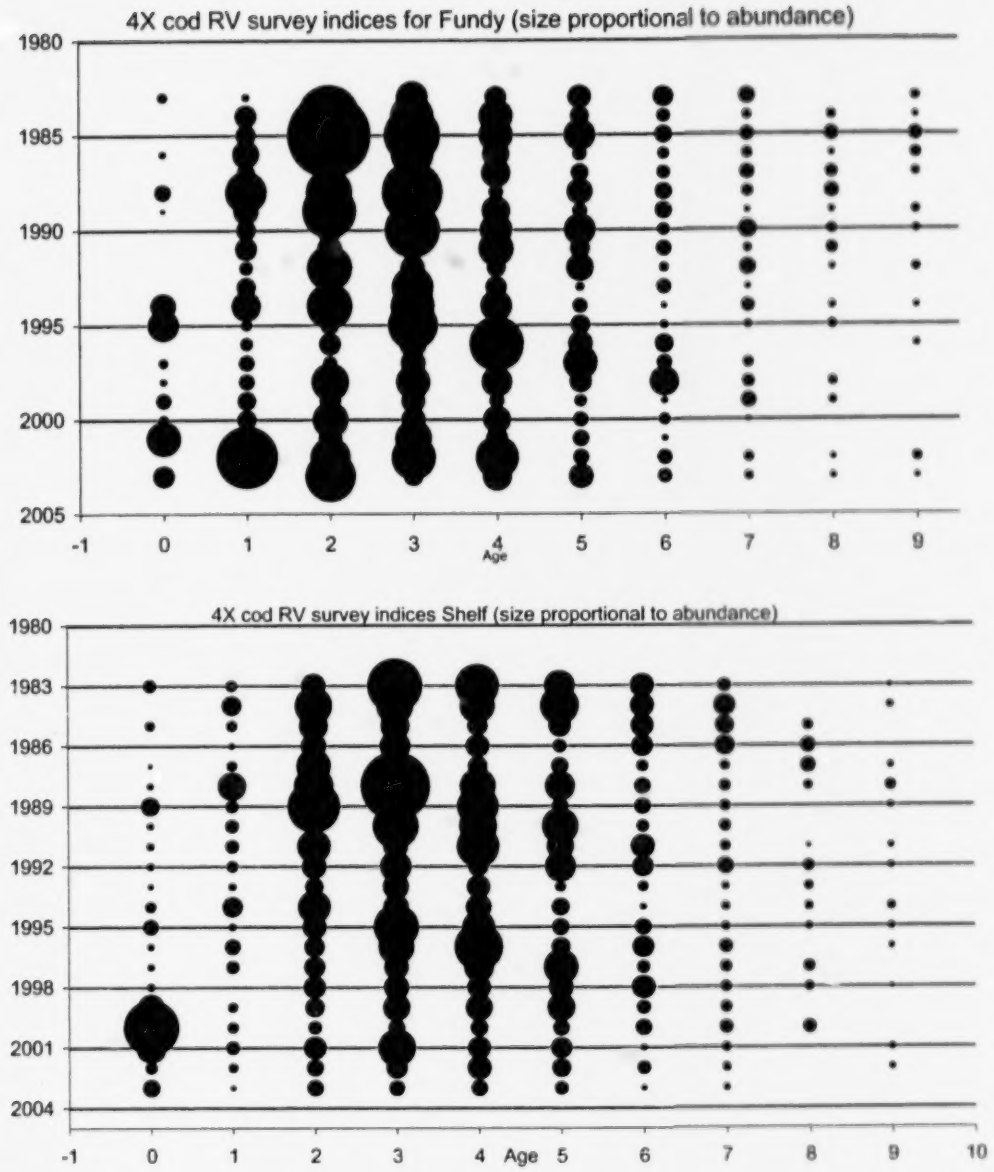

Figure 15. RV survey indices at age by area for 4X cod

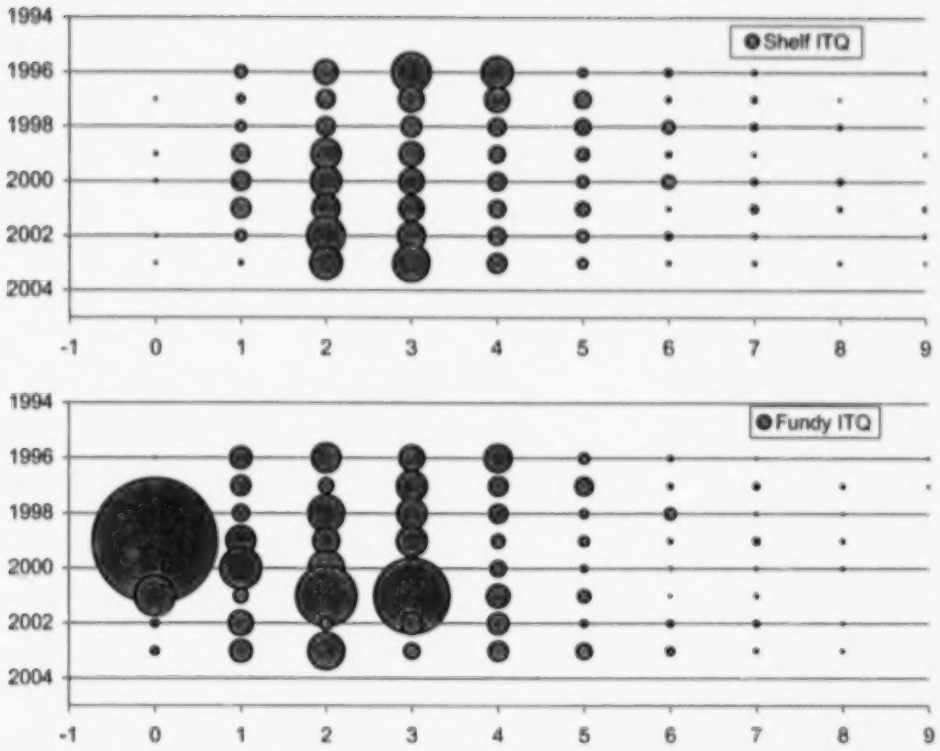

Figure 16. ITQ survey indices at age by area for 4X cod

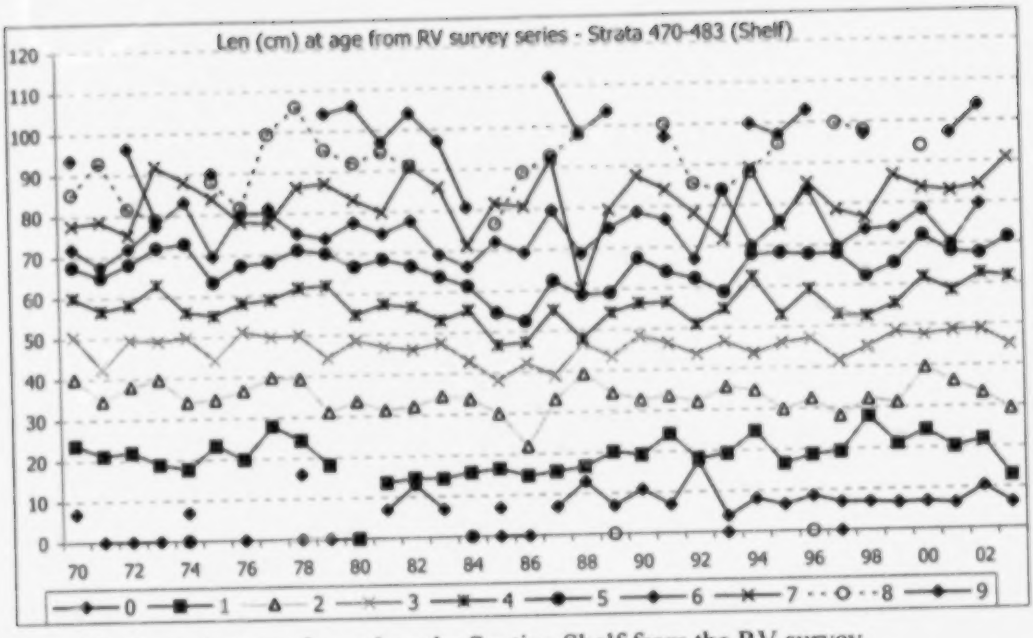

Figure 17a. Length at age for cod on the Scotian Shelf from the RV survey.

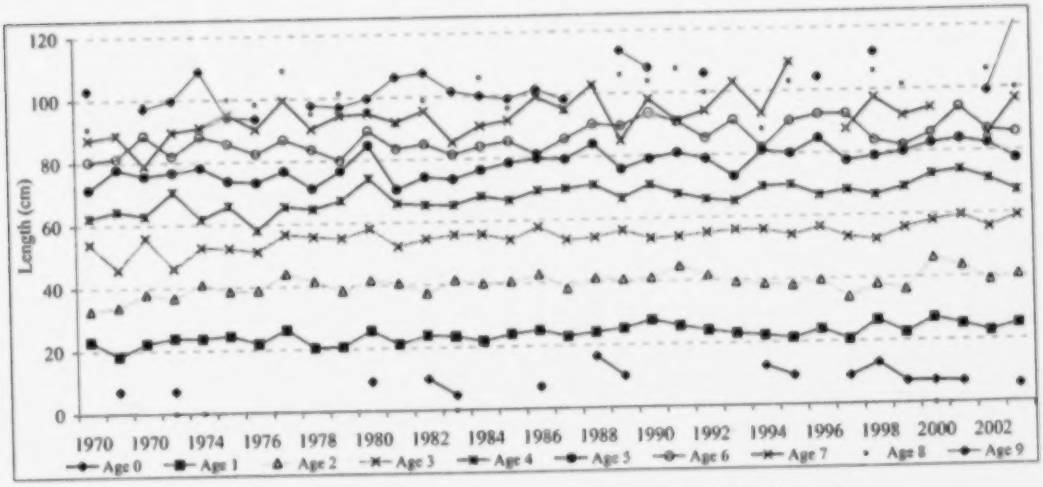

Figure 17b. Length at age for cod in the Bay of Fundy from the RV survey.

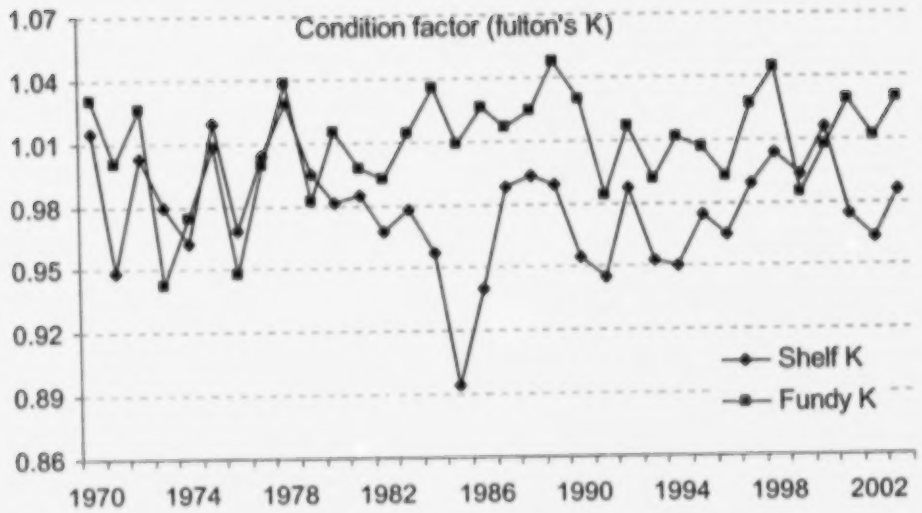

Figure 18. Condition factor for 4X cod from the annual RV survey.

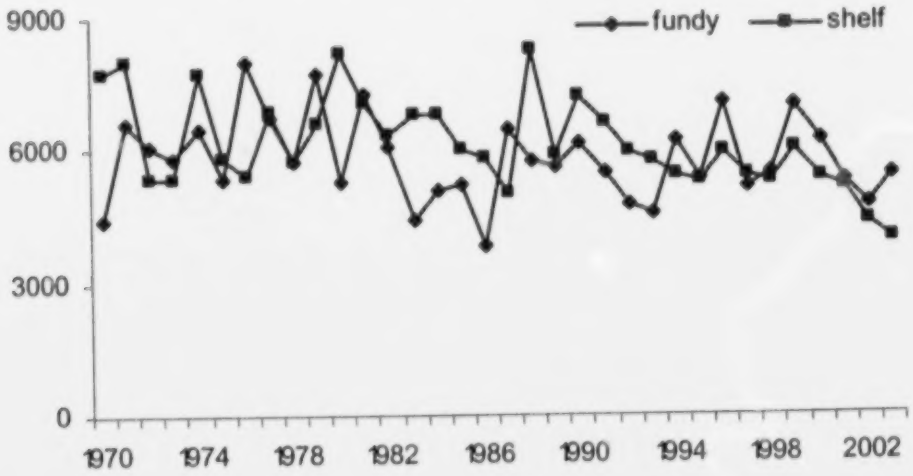

Figure 19. Area occupied by 4X cod from the annual RV survey.

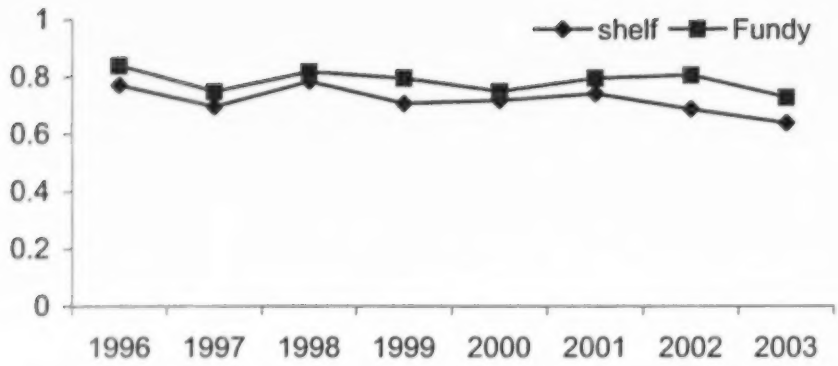

Figure 20. Proportion of ITQ survey sets where cod were caught.

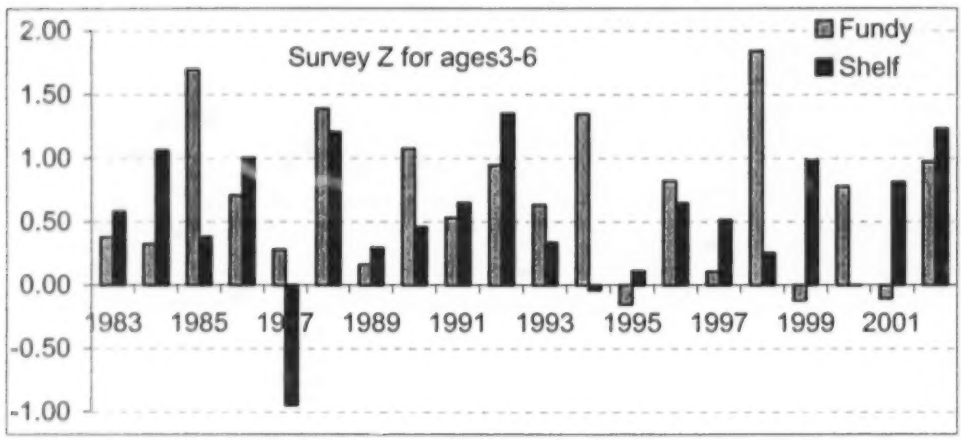

Figure 21. Total mortality estimates from the RV survey for 4X cod.

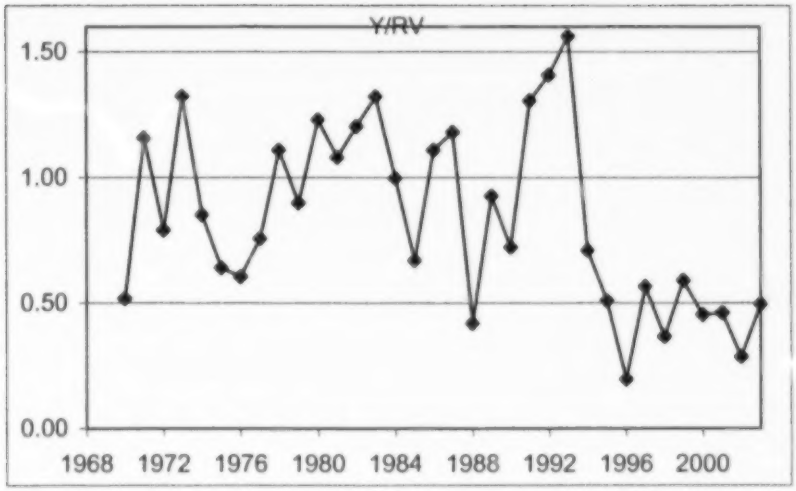

Figure 22. Relative fishing mortality estimates (fishery yield/RV biomass index) for 4X cod.